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NEW DICTATION TESTS.

DURING the Eighteenth Century the migration of the rural population townwards, which was the least agreeable feature of the first Census, and which has been going on ever since—not only in this country but also in the United States and in most parts of the Continent—had almost depopulated many villages. Then followed the American war and the long struggle precipitated by the French Revolution, with the terrible depression in industry which came in its train. Yet it was found that since 1750, when an approximate total was made up from various returns, the population had more than doubled.

***

EARLY yesterday morning an accident occurred on the Northern Section of the London and North-Western Railway. A fast luggage train was running from Preston, when a truck laden with heavy bars of iron toppled right over, blocking both the up and down lines with iron bars. About twenty trucks got off the rails, and the metals were twisted into all shapes for nearly a quarter of a mile. North and South traffic was considerably delayed, it being five hours before the single line could be got into working order. The guard of the train was badly cut.

***

OUR Cenus is not for scientific, but for taxable, purposes. It is intended mainly to enable the various Government departments to ascertain with something like precision the materials with which they have to deal, and the CHANCELLOR of the EXCHEQUER to estimate the number of mouths that have to be fed and the number of pockets on which he may rely for the national income. Hence the Census schedule is, so far as its queries are concerned, reduced to the barest particulars, though the opportunity afforded by the numbering might most advantageously be the occasion of bringing to light many facts of public importance which are not to be obtained in any other way, or with anything like the same accuracy.

***

IN giving a description of the mode by which whales are caught off the Norwegian coast, I would like to point out, as one interested in the business, and who has seen them captured, that a harpoon is fired into the whale, and that when the line which is attached to it is tightened, the shell that is fixed near the head of the weapon explodes. Death is not always instantaneous, and in many instances a boat has to be lowered, and the whale attacked with lances fixed on to long wooden rods, an operation which is sometimes attended with danger.

***

IT was the electors they asked to support them in this course. They appealed most especially to the working men for their support. The Government had enormously improved the defensive and offensive power of the Army and Navy, and had done what they could to secure the shores of England from insult and her commerce from attack; and they believed the working men would not think them less worthy of support because they were proud of the Empire which their forefathers had created, and which the Government were resolved to keep unimpaired and uninjured so long as its destinies were entrusted to their hands.

***

IMPROVEMENTS in tillage and stock-rearing enable a British or American farmer to grow food enough for the wants of thirty cotton-spinners or iron-smelters, or other eaters who are neither sowers nor reapers. The world is not half inhabited, and it is not cultivated, over a large extent of its surface, to one-hundredth part of its available fertility; while the seas, lakes, and rivers are capable of yielding an almost inexhaustible store of food. Hence, it seems to us that the prospect of an over-populated earth is very remote.

***

THE suggestion was taken up warmly by the chief hop-growing counties, and the liberal response it met with may be regarded as a general acknowledgment by the hop industry of the services the hon. gentleman has rendered with a view to reviving the prosperity of this particular branch of agriculture, and protecting the public against the adulteration of the most popular of all beverages. The testimonial consisted of a handsome silver salver, weighing 150 ounces, beautifully engraved, with a wreath of hops surrounding an inscription setting forth the services it was intended to commemorate.

***

THE evidence showed that the relief train from Plymouth reached Hemerdon Junction, a short distance from the scene of the accident, and the driver was there informed that everything was 'all right.' When about a quarter of a mile from the snowed-up train, he applied the brakes, but the engine ran into the rear carriage of the stationary train, and the man was thus killed. The jury found that necessary precautions were not taken by the Great Western Railway officials to make known the position of the snowed-up train, but they desired to make allowance for the exceptional severity of the weather and the strain on the heads of the various departments.

***

IT is a large and pretty building in half-timber style, on a brick foundation, and was finished in 1880; the basement might easily have been made proof against small guns fired point blank. It is surrounded by a large paddock and beautiful gardens and lawns, and has one large and several small ponds or tanks; at one corner is an additional enclosure containing the lines of the political agent's escort, guard-house, hospital, &c. The whole contains, perhaps, sixteen to eighteen acres, and is, or was, surrounded by a mud wall and ditch quite sufficient to act as a breastwork.

***

THE lecturer after referring to the injustice and inaccuracy of the charge frequently levelled against England of being an unmusical nation, and stating that there could hardly be any exaggeration in styling this country one of the pre-eminent musical nations in Europe two or three hundred years ago, traced the progress of the art in England as shown in the works of Early English composers. He defined the era of English music as having terminated with the death of Purcell, in whom the old and the new schools of English composition seemed to have been, in a measure, united.

***

THIS man placed the second brother on the throne as a puppet, he really grasping the power of the State. The unfortunate Rajah, a weak but estimable man, who had on several occasions performed valuable services for the British Government, was forced to abdicate, and fled to Calcutta to appeal for help. From the telegrams received it appears that the Chief Commissioner's visit was for the purpose of reinstating the rightful Rajah. It should be stated that the hill Chiefs have no voice whatever in the choice of the Rajahs.

A Course of Object-Lessons and Elementary Science.

(Adapted to the Syllabus of the New Code and of the London School Board.)

BY RICHARD BALCHIN,

Head Master under the School Board for London.

We now come to the work of the Third Standard. The syllabus for the year, following the lines indicated in a former article, seems naturally to arrange itself under three heads. First, we advance a stage in our system of classification, with a series of object lessons upon the types of our classes. Second, we have a group of experimental lessons to show the nature and purpose of scientific investigation, by which alone knowledge of any value is obtained. Third, we take the geographical work which we have decided shall be included in our Elementary Science Scheme, inasmuch as geography is not taken as a 'class subject.'

Our classification of natural objects has been, thus far, the three kingdoms of nature, together with the sub-kingdoms. That is to say, we have taken animals, vegetables, and minerals; and the sub-kingdoms, backbone and boneless animals; flowering and flowerless plants; rocks and metals. For Standard III. we will take some of these sub-kingdoms and divide them into classes. We may now introduce the terms vertebrata and invertebrata for our animal sub-kingdoms. Let us take vertebrate animals, flowering plants, and rocks, and make a sub-division into classes. We will leave invertebrate animals, flowerless plants, and metals for the work of a higher standard. Vertebrate animals we will classify as fish, amphibians, reptiles, birds, and mammals; flowering plants, as exogens and endogens; rocks, as igneous and sedimentary, or, if preferred, 'fire-formed' and 'water-formed.'

As we intend to base our classification of the vertebrata upon the structure and functions of the main organs, we must at the outset give one or two lessons upon animal organism.

Vertebrate Animals:—General Build.

1. Have ready two or three physiological diagrams, and, if possible, a large model or *torso* of the human body which can be taken to pieces. Also pictures of the interior organs of a fish, bird, etc. Have a boy out in front of the class. Make him stand upright. Why is he able to do this? Has a back bone. Where is this? What is at the top of it? Where is the bottom of it? What other bones are connected with it. Use the term 'vertebra' for each of the portions of the back bone as spoken of in Standard II. Introduce the new words 'vertebral column' and 'vertebrata.' This boy is a vertebrate animal. Name many others. Let another boy come out and press his ear against the boy's chest. What is it he hears? The heart. So lead on to the position and function of the other organs. After doing this with the boy, refer to the *torso* or to the pictures. Then show that a fish has organs somewhat similar, so has a bird, and so on.

Vertebrate Animals:—The Heart.

2. Have the physiological diagrams ready, and a large one of the human heart. If possible, have a sheep's heart on the table, as that is about the size of the human organ. Let a boy come to the front. Show the blood vessels on the back of his hand or in the arm, etc. Talk about them. Get the boys' ideas as to what they are. What is within them? Is the blood still or in motion? Flowing, the boys tell you. Flowing from where? To where? Let a boy come out whose veins on the back of the hand are rather prominent. Look at those veins so full of blood. Is the blood in them flowing towards the arm or towards the fingers? Boys cannot tell. Let the boy press his finger on the more central vein between the knuckles and pass it towards the wrist, still pressing upon the vein. The little pipe is still left full after the finger has passed. Now press and pass in an opposite direction. The vein is flat and empty after the finger has passed, and remains so until the pressure is withdrawn, unless another vein runs into the central one from the side. Do this with the vein on the temple or on any other accessible part of the body. So lead on to the fact that blood from all parts of the body is flowing *to* the heart. Now feel a boy's pulse. Get boys to feel their own. Let a boy come out in front. Instruct him where his pulse is and let him feel it. Grasp his arm tightly. Can he now feel his pulse? Not so plainly. Deduce from this, that there flows blood *from* the heart. The organ which keeps up this circulation is the heart. Notice the four chambers and name them, and by means of a large chalk drawing show how the blood enters and leaves the heart. All vertebrate animals have hearts, but the hearts of the various classes differ from each other. For instance, the heart of a fish is unlike that of a snake; that of a snake unlike that of a bird, which in its turn differs from that of a man. But all hearts are the organs of the circulation of the blood.

Vertebrate Animals:—The Lungs, etc.

3. Have ready the physiological diagrams, an enlarged picture of the human lungs, and the 'lights' of a sheep. The *torso*. Have out a boy, and talk about his breathing. What is this breathing? Do other animals breathe? What other animals? Does a cat breathe? A bird? A frog? A fish? In breathing, air passes in and out. In where? Show the *torso*. Point out the air passages. Give no other names at present but windpipe and right and left lung. Show the sheep's lights; cut them open and point out the ramifications of the air and blood vessels. This is where the air we breathe goes. Talk about this marvellous structure, and excite the boy's wonder about it. Perhaps they have seen a poor, timid, panting mouse, caught in a cage, or noticed the rapid respiration of their canary. Recur to the fact previously noted, that the air leaves the lungs loaded with impurities and should not be breathed over again. Do not at present say anything about the chemistry of respiration. Show by means of pictures the lungs of a bird, a frog, and the gills of a fish. Some boy is sure to ask questions about the breathing of other members of the animal kingdom. One boy during my lesson wanted to know whether a caterpillar

breathed. Another boy answered him by saying, 'Yes, I saw my silk-worm's body going in and out all along the back.' I was compelled to correct this by explaining that what the boy observed was the pulsation of the blood in the caterpillar, and that it 'breathed' through a great number of little holes all over its body, and had neither lungs nor heart.

Having now noticed, in a very elementary way, the organs of respiration and circulation, we can in our next lessons proceed further in our classification of the vertebrata, taking as our basis the structure and functions of these organs, from the lowest fish to the highest mammal.

(To be continued.)

ANSWERS TO PUPIL TEACHERS' TEST EXAMINATION.

FOURTH YEAR.

Algebra.—*contd.*

5.

$$\frac{x-12}{x-5}+\frac{x-5}{x-12}=2\tfrac{1}{12}$$

$$\frac{(x-12)^2+(x-5)^2}{(x-5)(x-12)}=\frac{25}{12}$$

$$\frac{2x^2-34x+169}{x^2-17x+60}=\frac{25}{12}$$

$$\begin{aligned}24x^2-1190x+5915&=\\ 24x^2-1258x+4440&\end{aligned}$$

$$4x^2-68x=1475$$

$$x^2-17x=\tfrac{1475}{4}$$

$$x^2-17x+(\tfrac{17}{2})^2=\tfrac{1475}{4}+\tfrac{289}{4}=\tfrac{1764}{4}=441$$

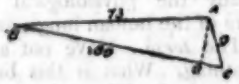
$$x-8\tfrac{1}{2}=\pm 21$$

$$x=29\tfrac{1}{2}\text{ or }-12\tfrac{1}{2}$$

Ans. $29\frac{1}{2}$ or $-12\frac{1}{2}$.

FOURTH YEAR.

Mensuration.



1. The greatest angle is the angle at A, because it is subtended by the greatest side BC.

Area of triangle $= \frac{80 \times AO}{2} = 40 \times AO$.

Now obtain area of triangle from length of sides 9, 73, 80.
Semi sum $= \frac{1}{2}(9+73+80) = 81$.

Area $= \sqrt{\{81(81-9)(81-73)(81-80)\}} = \sqrt{81.72.8.1} =$
$\sqrt{9.9.6.6.2.2.4} = 9.6.2.2 = 216$ sq. ft.

But this area $= 40 \times$ length of AO
$\therefore$ AO $= \frac{216}{40} = 5{\cdot}4$ feet.

Ans. 5·4 feet.

2. Semi sum $= \frac{48}{4} = 12$. Sum of AB and AC $= 24 - 8 = 16$.

Let x = length of AB, then $16 - x$ = length of AC.

Area of triangle $= \sqrt{12(12-x)(12-(16-x))(12-8)} =$
$\sqrt{48(12-x)(x-4)}$

But area of triangle is 24,

$$\therefore \sqrt{48(12-x)(x-4)} = 24$$

$$48(12-x)(x-4) = 576$$

$$-x^2+16x-48 = 12$$

$$x^2-16x = -60$$

$$x^2-16x+8^2 = -60+64 = 4$$

$$x-8 = \pm 2$$

$$x = 10 \text{ or } 6 = \text{length of AB}$$

$$16-x = 6 \text{ or } 10 = \text{length of AC}$$

Ans. 10 feet and 6 feet.

3. Let a = side of equilateral triangle

$a\frac{\sqrt{3}}{2}$ = perpendicular height of equilateral triangle.

$\frac{\sqrt{3}}{4}a^2$ = area of equilateral triangle.

$3a$ = perimeter of " "

$\therefore$ $3a$ = circumference of circle

$\frac{3a}{2\pi}$ = radius "

$\left(\frac{3a}{2\pi}\right)^2 \times \pi$ = area of circle.

$$\frac{\text{area of circle}}{\text{area of triangle}} = \frac{\frac{9a^2}{4\pi^2}\times\pi}{\frac{\sqrt{3}}{4}a^2} = \frac{9a^2}{4\pi} : \frac{\sqrt{3}}{4}a^2 =$$

$$\frac{9}{\pi} : \sqrt{3} = 9 : \sqrt{3}\pi$$

or $3\sqrt{3} : \pi$

Ans. $3\sqrt{3} : \pi$, or $5{\cdot}196 : 3{\cdot}1416$.

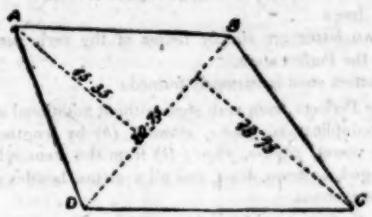
Mensuration.

THIRD YEAR.

1. BCD is a right angled triangle, of which
the hypotenuse BD = 41 feet
the base CD = 9 feet;
required BC.

sq. on BC = sq. on BD − sq. on CD
$= 41^2 - 9^2$
$= 1681 - 81 = 1600$
$BC = \sqrt{1600} = 40$ ft.
∴ AB (the distance the top has fallen) = (41 − 40) ft. = 1 ft.
Ans. 1 foot.

2.



Area of trapezium = area of triangle ABD + area of triangle BCD

$$= \frac{20{\cdot}75 \times 15{\cdot}35}{2} + \frac{20{\cdot}75 \times 18{\cdot}75}{2}$$

$$= \frac{20{\cdot}75 \times 34{\cdot}1}{2} = 20{\cdot}75 \times 17{\cdot}05$$

= 353·7875 sq. chains
= 35·37875 acres
or 35 ac. 3 sq. chains 7875 sq. links
Ans. 35·37875 acres.

3.

In triangle ABC semi-sum of sides = ½ (17 + 105 + 116) = 119.
Area = $\sqrt{\{119 \times (119 - 17) \times (119 - 105) \times (119 - 116)\}}$ =
$\sqrt{(119 \times 102 \times 14 \times 3)} = \sqrt{(17.7.17.6.7.2.3)} = 17.7.6 = 714$.
In triangle DEF
area = ½ (45 × 28) = 45 × 14 = 630,
ratio between areas = 714 : 630 = 17 : 15.
Ans. 17 : 15.

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This New Latin Course (specially written for Scholarship Candidates) was begun in our issue of February 7th (No. 4., vol. XI.).

EXERCISE XX. (*continued*).

Decline as lex: *rēg-*, M., king; *pāc-*, F., peace; *ŏp-*, F. (pl.), wealth; *princip-* (*eps*), M.F., chief; *prĕc-*, F., prayer; *judec* (*ex*), M.F., judge; *conjŭg-* (*conjunx*, also as Nom.), M.F., husband or wife.

as pēs: *juventut-*, F., youth; *voluntāt-*, F., wish; and all in tut- and tāt-; *quiēt*, F., rest; *cŏmīt-* (*ĭs*), M.F., companion; *custōd-*, M.F., guard.

as consul: *exul*, M.F., exile.

as ămor: *uxōr-*, F., wife; *sŏrōr-*, F., sister; *viatōr*, M.F., traveller (and all subst. from verbs in tor or sor); *carcĕr-*, M., prison.

as păter: *māter-*, F., mother; *frāter-*, M., brother; *accĭpĭter*, M., hawk (no others).

as honōs: *flōr-*, M., flower; *mōr-*, M., custom.

as cinis:

as lĕgion: *pūgiōn-*, M., dagger; *conjuration-*, F., conspiracy (and all subst. in -io, esp. in -tio and -sio, F., from verbs); *latrōn*, M., highwayman, pirate; *caupōn*, M., innkeeper.

as hŏmo: *magnitudŏn*, F., greatness (and all other subst. in -dŏn and gŏn-; *carŏn-* (*carn-*), F., flesh.

2. *Pătĕr*, M., father; *mātĕr*, F., mother; *frātĕr*, M., brother; *accĭpĭtĕr*, M., hawk. Drop ĕ in oblique cases, as Acc. *pătrem*, G. *pătris*, D. *pătri*, &c.

3. Do not be misled by *căn-is*, stem *căn-*, c., dog; *jŭvĕn-is*, stem *jŭvĕn*, c., youth; *vŏlŭcer-is*, stem *vŏlŭcer-*, F., bird; *sen-ex*, stem *sen-*, M., old man; (the long stem *senec-* appears in *senec-tūs*, F., old age); *mens-is*, stem *mens-*, M., month (G. pl. *mensum*, seldom *-ium*).

4. Stems in *tāt-* have often Gen. pl. in *ium*, *e.g.*, *civitat-ium*, as well as the regular *civitātum*.

NEUTERS.

N. and Acc. sing. are the same as the stem. Some stems in ĕr- change to ŭr-; some in ŏs and es, originally ŏs, to ŭs. N. Acc. pl. end in ă.

	caput-, head.	*cord-*, heart.	*agmĕn-* { army (on the march).
Sing. N.A.	căpŭt	cor (drop final d)	agmen
G.	capit-*ĭs*	cord-*ĭs*	agmĭn-*ĭs*
D.	capit-*ī*	cord-*ī*	agmĭn-*ī*
Abl.	capit-*ĕ*	cord-*ĕ*	agmĭn-*ĕ*
Pl. N.A.	capit-*ă*	cord-*ă*	agmĭn-*ă*
G.	capit-*um*	(wanting)	agmĭn-*um*
D. Abl.	capit-*ĭbus*	cord-*ĭbus*	agmĭn-*ĭbus*

Decline as cor: *lac*, stem *lact-*, milk (Sing. only).
as agmen: *discrimen*, danger; *nōmĕn*, name; *grāmĭn*, grass.

		pāpāver-, poppy.	*rōbor-*, hard wood, strength.
Sing.	N.A.	pāpāvĕr	rōbŭr
	G.	pāpāvĕr-*īs*	rōbŏr-*īs*
	D.	papaver-*ī*	rōbŏr-*ī*
	Abl.	papaver-*ĕ*	rōbŏr-*ĕ*
Pl.	N.A.	papaver-*ă*	robor-*ă*
	G.	papaver-*um*	robor-*um*
	D. Abl.	papaver-*ĭbus*	robor-*ĭbus*
		ŏpĕs- (orig.-*ĕs*) work.	*corpŭs*, body.
Sing.	N. A.	ŏpŭs	corpŭs
	G.	ŏpĕr-*ĭs*	corpŏr-*ĭs*
	D.	oper-*ī*	corpor-*ī*
	Abl.	oper-*ĕ*	corpor-*ĕ*
Pl.	N.A.	oper-*ă*	corpor-*ă*
	G.	oper-*um*	corpor-*um*
	D. Abl.	oper-*ĭbus*	corpor-*ĭbus*

So
cădāvĕr, corpse
ĭtĕr, N.A. Sing. } journey
ĭtĭnĕr-*ĭs* }
jūgĕr-ă, pl., acres
(o- stem in sing.)
vĕr, spring

So
ĕbŭr, ivory
fēmŭr, thigh
(oblique cases also from stem femin-)
jĕcŭr, liver
(also g. jociner-*is*, &c.)

So
scelus, crime
foedŭs, treaty
gĕnŭs, kind
lătŭs, side
mūnŭs, gift, duty
ŏnŭs, burden
pondŭs, weight
valnŭs, wound

So
dĕcŭs, glory
facĭnŭs, deed, crime
pectŭs, breast
tempŭs, time
stercus, manure
pĕcus, cattle
aes, aer-*is*, bronze

In ur: *murmur-*, murmur. In us: *jūs*, law (*juris*).
In or: *aequŏr*, level, sea; *marmŏr-*, marble.

ADJECTIVES (consonant stems).

vetus, old (stem *vĕtĕs*, orig. *vetos*) *melior*, better.

		M.F.	NEUT.	N.
Sing.	N.	vetus } vetus	mĕliŏr }	mĕlius
	Acc.	veter-*em* }	mĕliŏr-*em* }	
	G.	veter-*is*	melior-*is*	
	D.	veter-*ī*	melior-*ī*	
	Abl.	veter-*e*	melior-*e* (sometimes *ī*)	
Pl.	N. Acc.	veter-*es*, veter*a*	melior-*es*, melior*a*	
	G.	veter-*um*	melior-*um*	
	D. Abl.	veter-*ibus*	melior-*ibus*	

Similarly: *dīvĕs*, rich, *dīvĭtis* (n. pl. *dĭbĭă*)
princeps, chief, *princip-is* (no neut. pl.)
ūbĕr, fertile, *uber-is*
ālis, winged, *alīt-is*
trĭpēs, three-footed
quădrūpēs, four-footed } as *pes*
dēsĭdĭa, slothful, *desīd-is*
Inops, needy, *inŏp-is* (abl. sing. *ĕ*, no neut. N.A. pl.).

As melior: all comparative adjectives. These end in *-ior*.

Note.—The *i* in the abl. has crept in from the far more common *-i* declension of adjectives.

THE PERFECT TENSES (*Indicative Mood*).

These are three in number: the Perfect, I have done, or Indefinite, I did; the Pluperfect, I had done; and the Future Perfect, I shall have done.

The person endings are as follows:—

		Perf.	Plupf.	Fut. Perf.
Sing.	1.	-ī	-ĕram	-ĕrŏ
	2.	-istī	-ĕrās	-ĕrĭs
	3.	-it	-ĕrăt	-ĕrĭt
Pl.	1.	-imus	-ĕrāmŭs	-ĕrĭmus
	2.	-istĭs	-ĕrātĭs	-ĕrĭtĭs
	3.	-ĕrunt	-ĕrant	-ĕrint

The corresponding Pass. (or Deponent) Tenses are formed by using the Perfect Participle with *sum*, *eram*, *ero*; and for the Infinitive, *esse:* as

amatus sum, { I was / I have been } loved
amatus eram, I had been loved
amatus ero, I shall have been loved.

Infin. -isse:

The two latter are simply tenses of the verb *sum*, to be, added to the Perfect stem.

The Perfect stem is variously formed:

1. Strong Perfects from verb stem without additional suffix, (*a*) by reduplication, *tend-o*, *tĕtend-ī*, (*b*) by lengthening the stem vowel, *fĭg-ĭ-o*, *fīg-ī*; (*c*) from the stem syllable unchanged, as *dĕu-o*, *dĕu-ī*, and all a- stems, besides a number of cons. stems.
2. Weak Perfects by adding the suffixes *-sī*, *-vī* or *-uī*; *-sī* to some cons. stems, and some shortened *e-* and *i-* verbs; *-vī* to nearly all *a-* and *ī-* verbs, *dmā-vī-*; *uī*, to many cons. stems and most *e-* stems, as *mŏne-ō*, *mŏnuī*.

The 1891 Scholarship Examination.

BY DR. GEORGE BEACH, M.A.

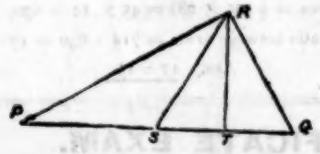
Co-Author of 'A Manual of our Mother-Tongue,'
Author of 'Elements of English,' 'Entertaining Readers.'

(N.B.—CERTIFICATE STUDENTS WOULD PROFIT BY STUDYING THIS ARTICLE.)

(1) Our Routines will commence again in our next issue, and will in ten weeks go over the whole Scholarship course in fuller detail than previously. This we shall be enabled to effect through omitting (*a*) the more elementary portions of the Pupil-Teacher curriculum, *and* (*b*) the Science and Art subjects.

(2) *A few* EUCLID DEDUCTIONS *which have puzzled our Correspondents.*

Let PQR be any right-angled triangle, having the right angle at R, and let RS be drawn bisecting PQ at S, and RT be drawn at right angles to PQ and meeting it at T. It is required to show that the angle SRT is equal to the difference of the acute angles at P and Q.



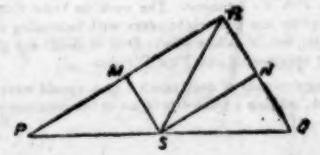
The best method of demonstrating this theorem is by means of two other theorems (*a*) and (*b*), which shall be subsequently proved.

∵ RS = (theorem (*a*)) ∴ ∠ SPR = ∠ SRP and by theorem (*b*) ∠ PRT = ∠ PQR.

∴ the difference between PRT and SRP = the difference between the angles at P and Q, but SRT is this difference.

Q.E.D.

THEOREM (*a*).—*The middle part of the hypotenuse is equi-distant from the three angles.*



S being middle point of hypotenuse, to prove that SR = SP = SQ.

Draw SM parallel to QR.

Then the angles PMS and SMR are right angles (I. 29), and PR is bisected at M (Theorem (*c*)).

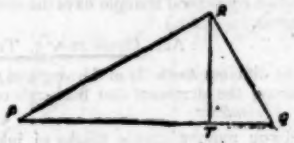
∵ PM = MR and MS is common, and the ∠ PMS = ∠ SMR ∴ base SR = base SP.

Similarly by drawing SN parallel PR, SR may be proved = to SQ. Q. E. D.

The student should also try to prove this theorem by producing RS to K, making SK = SR, and joining KP and KQ; also by the method of *reductio ad absurdum*, *e.g.*, If SR be not = to SP, one of them is greater. First, let SR be greater than SP, then ∠ SPR is greater than ∠ SRP, similarly ∠ SQR is greater than SRQ. ∴ ∠s SPR and SQR are greater than ∠ PRQ. But by I. 32 these are =. ∴ SR is *not* greater than SP. Similarly it may be proved that SR is not less than SP, for then ∠s SPR and SQR would be less than PRQ. Therefore, SR = SP = SQ. Q. E. D.

Note also that this theorem is the converse of Prop. 31, Book III. Also prove the following deduction: 'If SRQ be a triangle having its sides SR and SQ equal, and QS be produced to P so that SP = SQ, and PR be joined, then ∠ PRQ is a right angle.

THEOREM (*b*).—*If PRQ be a triangle right-angled at R, and RT be drawn perpendicular to the hypotenuse PQ, then the three triangles PRQ, PTR and RTQ are equi-angular.*

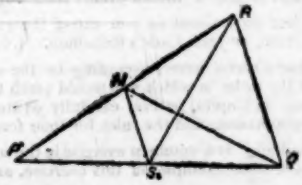


In triangles PRQ and PTR, ∠ PRQ = PTR, and angle RPT is common, ∴ (I. 32) remaining ∠ PQR = remaining ∠ PRT.

In triangles PRQ and RTQ, ∠ PRQ = RTQ and angle RTQ is common, ∴ (I. 32) remaining ∠ TQR = remaining ∠ QRT. Q. E. D.

The connection between this theorem Euclid II. 14, Euclid VI. 8, and Euclid VI. 13, should be investigated by the more advanced reader.

THEOREM (*c*).—*In* ANY *triangle PRQ, if PQ be bisected at S, and SM be drawn parallel to RQ, then PM = MR.*



Join SR and MQ.

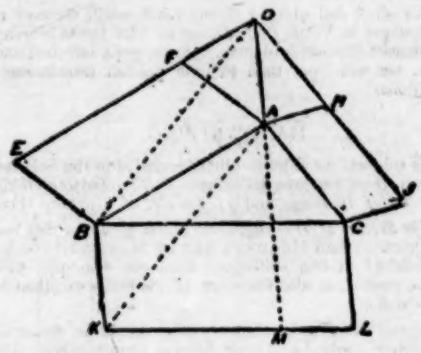
∵ PS = QS, triangle PMS = triangle QMS (I. 38), and ∵ MS is parallel to RQ ∴ triangle QMS is also = to triangle RMS (I. 37), ∴ triangle PMS = triangle RMS ∴ base PM = base RM.

Try also to prove this theorem by producing MS to K; making MK = MS and joining KR.

The following properties should be demonstrated, that SM = ½ RQ, that triangle SPM = ¼ of triangle PRQ, and the advanced reader should note the connection of this theorem with Euclid VI. 2, and Euclid VI. 19.

(3) ONE OF THE FINEST DEDUCTIONS EVER DISCOVERED:

On the sides AB and AC of ANY *triangle,* ANY *parallelograms are described externally. The sides parallel to BA and CA are produced to meet in D and DA is joined. Prove that a parallelogram on BC with the other side BK parallel and equal to DA is equal to the sum of the parallelograms on BA and CA.*



Let AE, AJ and BL be the three parallelograms.
It is required to prove that BL = the sum of AE and AJ.
Produce DA to meet KL in M and join DB and AK.
Then BM and MC are also parallelograms.
∵ AD is parallel to BK ∠ BAD = ∠ ABK (I. 29).
And AD = BK and AB is common, ∴ base BD = base AK and triangle BAD = triangle ABK (I. 4).
But BAD = ½ parallelogram AE, and ABK = ½ parallelogram BM (I. 41).
∴ parallelogram AE = parallelogram BM.
Similarly it may be proved that parallelogram AJ = parallelogram MC.
∴ parallelogram BL = the sum of parallelograms AE and AJ. Q. E. D.

Euclid I. 47 (most important as it is) is only one case of this splendid deduction. For by proving AD = BC (which is already done), and AM perpendicular to BC, the proposition is at once demonstrated.

(4) *Optional* ROUTINE FOR WEEK COMMENCING 13TH APRIL, 1891.

DAYS.	FIRST HOUR.	SECOND HOUR.	THIRD HOUR.
M.	Simultaneous Quadratics *or* Revise any Domestic Econ.	Growth of our Colonial Empire	Latin *or* French
TU.	Euclid, Second Book, *or* Sectional Paper Diagram of Chemise	The Seasons	Science
W.	Miscellaneous Questions Arithmetic	Drawing	Derivation of Words
TH.	Problems involving Simultaneous Quadratics *or* Revise any Domestic Econ.	Growth of our Colonial Empire	Latin *or* French
F.	Deductions on Second Book Euclid *or* Sectional Paper Diagram of Night Shirt	The Planetary System	Syntax from Text Book
S.	Mensuration *or* Miscellaneous Questions in Arithmetic	Repetition and Macaulay's Essay on Boswell's Life of Johnson	Notes of a Lesson on Prepositions and Conjunctions —— Manuscript Letters / Science

(5) We shall feel obliged if any readers will forward to us those passages in Virgil Book I., or in 'La Jeune Sibérienne' which present difficulties to them. As we get a sufficient number of these, we will from time to time publish translations and explanations.

HANDWRITING.

In this subject, as in most others included in the Scholarship curriculum, there are three divisions—(*a*) *The Science of Writing*, (*b*) *The Art of Writing*, and (*c*) *The Art of Teaching Writing*.

(*a*) *The Science of Writing.*—No better guide for this branch can be procured than HUGHES'S ART OF HANDWRITING, p. 72, and published at one shilling. *Gladman* also, pp. 59—71, should be studied, as also some one of the many excellent series of copy-books.

Largehand small letters (not capitals) should be first studied, the characters resolved into their different elements, their relative sizes compared, and the degrees of difficulty in forming them should be noted.

The Department says, that '*Largehand in the Code may be taken as a general rule to mean writing in which the lines between which it is written are not less than three-eighths of an inch apart; but providing that the writing is bold and legible, and the proper forms and proportions of the letters are duly observed, my Lords do not desire to prescribe a uniform rule, either as to its exact style or size.*' '*Candidates are also not* TO PAINT *their letters in the Copy-setting exercise, but to take care that the copy is clean and without erasures.*'

In Smallhand the body of the letter is reduced from three-eighths of an inch to one-eighth, and all letters (with the exception of *p* and *t*) with long loops or strokes are carried three-sixteenths of an inch above or below the lines.

The letters admit of the same grouping as in Largehand.

All that the Department requires is, that '*Smallhand shall be running, free, and symmetrical, as well as legible and clear.*' These first two qualities merely signify ease of execution, the last two legibility, and the third one correctness of form.

What is known as the 'Civil Service hand' can, of course, be recommended.

Text-hand is scarcely ever asked for. The body of the letter should be one-quarter of an inch long, the long strokes (with the exception of *p* and *t*) are one-quarter of an inch longer.

In all three hands the Candidate should err rather towards the maximum than the minimum of size. '*Writing,*' say my Lords, '*as taught in schools is apt to be too small and indistinct. Pupils should be taught to write a firm, round, legible hand.*' Blackboard practice is an excellent means of producing the requisite boldness and clearness.

(*b*) *The Art of Writing* has been by no means improved by the invention of Printing and the advent of steel pens. Now-a-days good and rapid writing is seldom met with. Most voluminous writers are very bad penmen, for the pressure of the present day, and its utilitarian aims, sacrifices Caligraphy (beautiful writing) to speed.

In order to write well (1) good materials should be used, (2) the body should be properly disposed, (3) the pen should be freely yet firmly held, (4) and there should be no hurry. To descant upon these points is beyond our special limits, and we must refer our readers to Mr. Hughes's Manual above-mentioned.

(*c*) *The Art of Teaching Handwriting.*—As in ALL teaching much must depend upon the teacher and his own proficiency and character. We can simply offer a few remarks.

(1) Begin paper writing as soon as possible. (2) Don't advance the pupil too fast. (3) Let the writing lessons be short. (4) Stick to one series of copybooks. (5) Don't allow writing in exercise books to be slovenly and ill-formed. (6) Write often yourselves in the scholars' copybooks. (7) Occasionally set copies on blackboard to be written in exercise books. (8) Don't allow too much tracing. (9) Much practice in figuring is required.

DICTATION, ETC.

Omissions and erasures are counted as mistakes. There will be plenty of space allowed, so that no writing between lines or division of words in two consecutive lines is permitted. The passage dictated has to be punctuated by the candidate.

Three things determine the handwriting marks:—(1) The special passages given for copy-setting. (2) The Dictation exercise, and (3) The handwriting and figures throughout all the papers supplied to the Penmanship examiner.

OPTIONAL QUESTIONS.

1. Three men hire a pasture for £42 12s. One puts in 10 oxen for 9 months; another, 12 oxen for 8 months, the third 14 oxen for 7 months. What part of the rent should each pay?
Ans. £13 10s.; £14 8s.; £14 14s.

2. Find the square root of 529·4601. Ans. 23·01.

3. If a straight line be divided into any two parts, the squares on the whole line, and on one of the parts, are equal to twice the rectangle contained by the whole and that part, together with the square on the other part.

Write down the corresponding form in Algebra. (*Males.*)

4. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line. (*Males.*)

5. In equal circles the angles which stand upon equal arcs are equal to one another, whether they be at the centres or at the circumferences.

Show that the arcs subtended by one of the angles of an equilateral triangle, and by one of the smaller angles of a right angled isosceles triangle, which are inscribed in a circle are in the ratio of four to three. (*Males, Scotland.*)

6. A circle and an equilateral triangle have the same perimeter. Compare their areas. (*Males.*)
Ans. Circle 21 $\sqrt{3}$, Triangle 22.

7. Describe the different methods of darning and the purposes of the stitch, naming the garments and materials on which it is generally used. (*Females.*)

8. How would you remove grease marks or ink spots from clothing? (*Females.*)

9. Write a short essay on '*Closer union with our Colonies.*'

10. Write notes of a first lesson on adverbial sentences (or clauses).

11. Briefly describe the physical features of Canada.

12. Draw a political map of Australia and one of New Zealand.

13. Enumerate the islands (excluding Europe) belonging to the British Empire, and state their value to us. (*Scotland.*)

14. What are the following dates memorable for:—1718, 1727, 1802, 1811, 1849, 1858?

15. Give a short sketch of Indian events since 1841.

16. Give as clear an account as you can of the causes of the Pilgrimage of Grace, *or* Jack Cade's Rebellion. (*Scotland.*)

17. Classify the *Capital* letters according to the similarity of their forms, and the order in which you would teach them. Give specimens of any six Capital letters, carefully written, so as to illustrate their proportions, and the rules for their formation.

18. 'Word-building' is a common exercise in the upper classes of a school. Give some examples of this exercise, and say what is the use of it.

CORRESPONDENCE.

All Correspondents, except extremely recent ones, have now had their requests met within the Articles themselves.

(To be continued.)

MUSIC FOR MAY.

Songs for Braiding the Maypole, Welcoming May, Songs of Birds, Flowers and Sunshine, Cantatas, Services of Songs, &c., for the Season.

Send for J. CURWEN & SONS, List,

London: 8 & 9, WARWICK LANE, E.C.

Practical Perspective for Pupil Teachers.

E. G. BAKER, B.SC., B.A.,
Vice-Principal of the Training College, Carmarthen.

PERSPECTIVE PROJECTION OF CURVES.

When dealing with the projection of polygons it was shown that the angular points of the various figures could be obtained by means of auxiliary lines, chosen at our convenience, the points of intersection of these lines being the angular points of the figures. Thus for a hexagon in a horizontal plane, we may employ a rectangle constructed around the hexagon so that the angular points of the latter are on the sides of the former, and project the rectangle so as to obtain the projections of those points on its sides which are the required angular points of the hexagon. It was shown that we thus avoided the use of more than two vanishing points, though it was also pointed out that there is in reality no other reason than our own convenience why we should not use more than two vanishing points. At a later stage we have also seen that the vanishing points of the diagonals may often be used instead of those of the sides of a rectangle, and that in fact there is no fixed method which should be employed for polygons and other figures.

Now in the case of curved lines we cannot find vanishing points as for straight lines, and we are compelled to obtain the projections of certain points on the curve and then complete the projection by sketching a line through those points. It is manifest that the result will in general be more accurate the greater the number of points we obtain the projections of, those points being at the same time equally distributed along the curve.

Curves which lie in horizontal planes will be projected by means of horizontal intersecting lines whose points of intersection lie on the curve. The figure below will illustrate the general principles which should guide us in such cases.

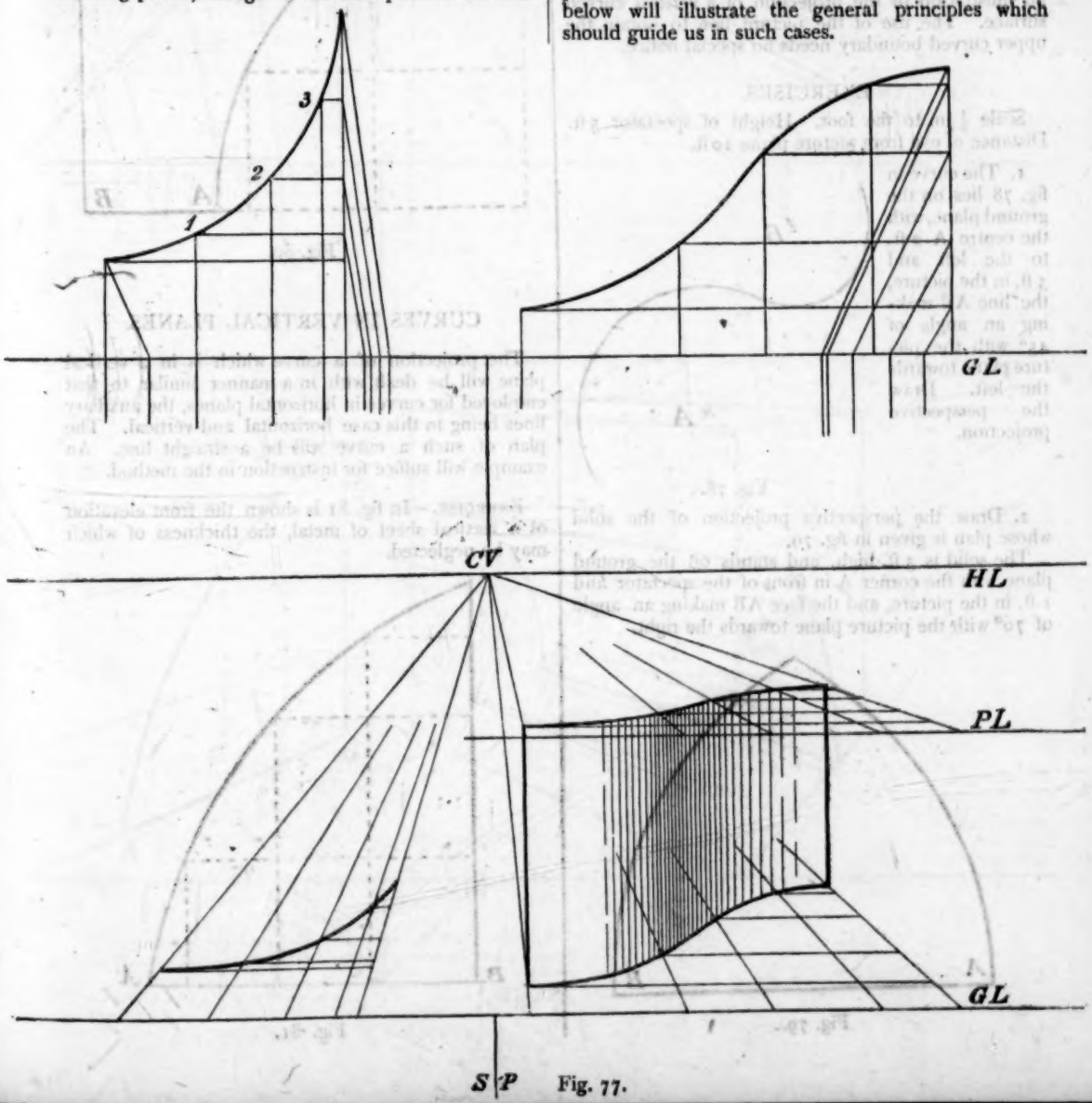


Fig. 77.

The above figure illustrates one out of various methods which might be employed to project curves which lie in horizontal planes. First, observe the left hand side of the figure. The plan of a curve lying on the ground plane is shown in position, and its projection has been obtained by means of intersecting lines parallel and perpendicular to the ground line. The advantage of this method is that we require only one vanishing point, which is the centre of vision.

For this reason we recommend the student to employ it on most occasions. His own judgment will decide when any other system of lines will be more convenient.

Choose the points 1, 2, 3, &c., so that they may be nearly at equal distances apart. The figure will be sufficient guide to the projection which gives these points, and the curve must be sketched passing through them.

The exercise on the right hand side of the figure is an illustration of the projection of a vertical curved surface. The use of the picture line to obtain the upper curved boundary needs no special notice.

EXERCISES.

Scale ½ in. to the foot. Height of spectator 5 ft. Distance of eye from picture plane 10 ft.

1. The curve in fig. 78 lies on the ground plane, with the centre A 2 ft. to the left and 3 ft. in the picture, the line AB making an angle of 45° with the picture plane towards the left. Draw the perspective projection.

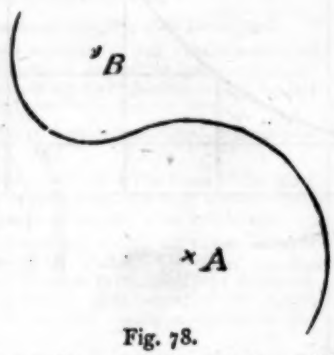


Fig. 78.

2. Draw the perspective projection of the solid whose plan is given in fig. 79.

The solid is 3 ft. high, and stands on the ground plane with the corner A in front of the spectator and 1 ft. in the picture, and the face AB making an angle of 70° with the picture plane towards the right.

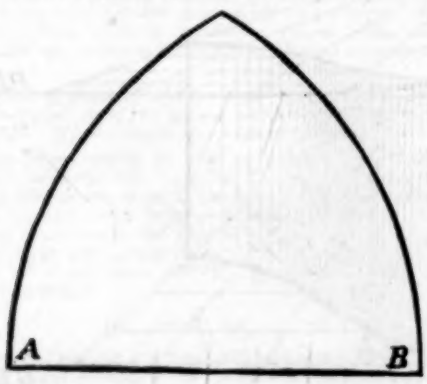


Fig. 79.

3. Fig. 80 is the plan of a solid standing on the ground plane, with the corner A 1 ft. to the right and 1 ft. in the picture, and the face AB making an angle of 40° with the picture plane towards the right. Place the solid in perspective, its height being 4 ft.

The dotted lines shown may be used to project the curved face.

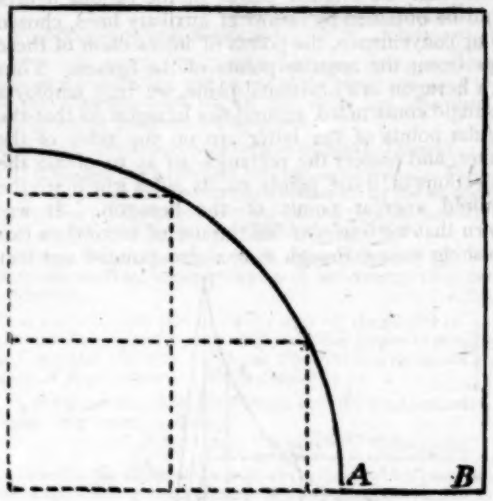


Fig. 80.

CURVES IN VERTICAL PLANES.

The projection of a curve which is in a vertical plane will be dealt with in a manner similar to that employed for curves in horizontal planes, the auxiliary lines being in this case horizontal and vertical. The plan of such a curve will be a straight line. An example will suffice for instruction in the method.

EXERCISE.—In fig. 81 is shown the front elevation of a vertical sheet of metal, the thickness of which may be neglected.

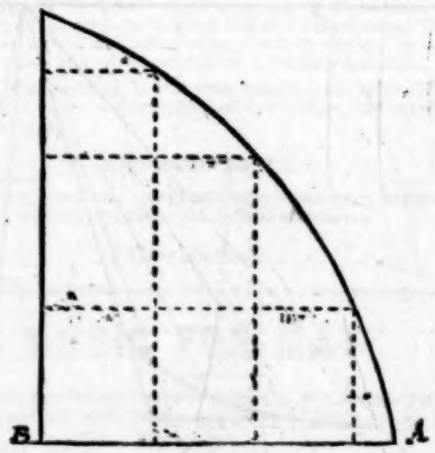


Fig. 81.

Fig. 82 shows the method of projecting the figure, the edge AB resting on the ground and making an angle of 45° with the ground line.

The vertical and horizontal lines are obtained in perspective by means of the plan and a height line, and no difficulty should be experienced in re-working the problem.

In fig. 82 is also shown the projection of a solid, of which fig. 80 is the end elevation.

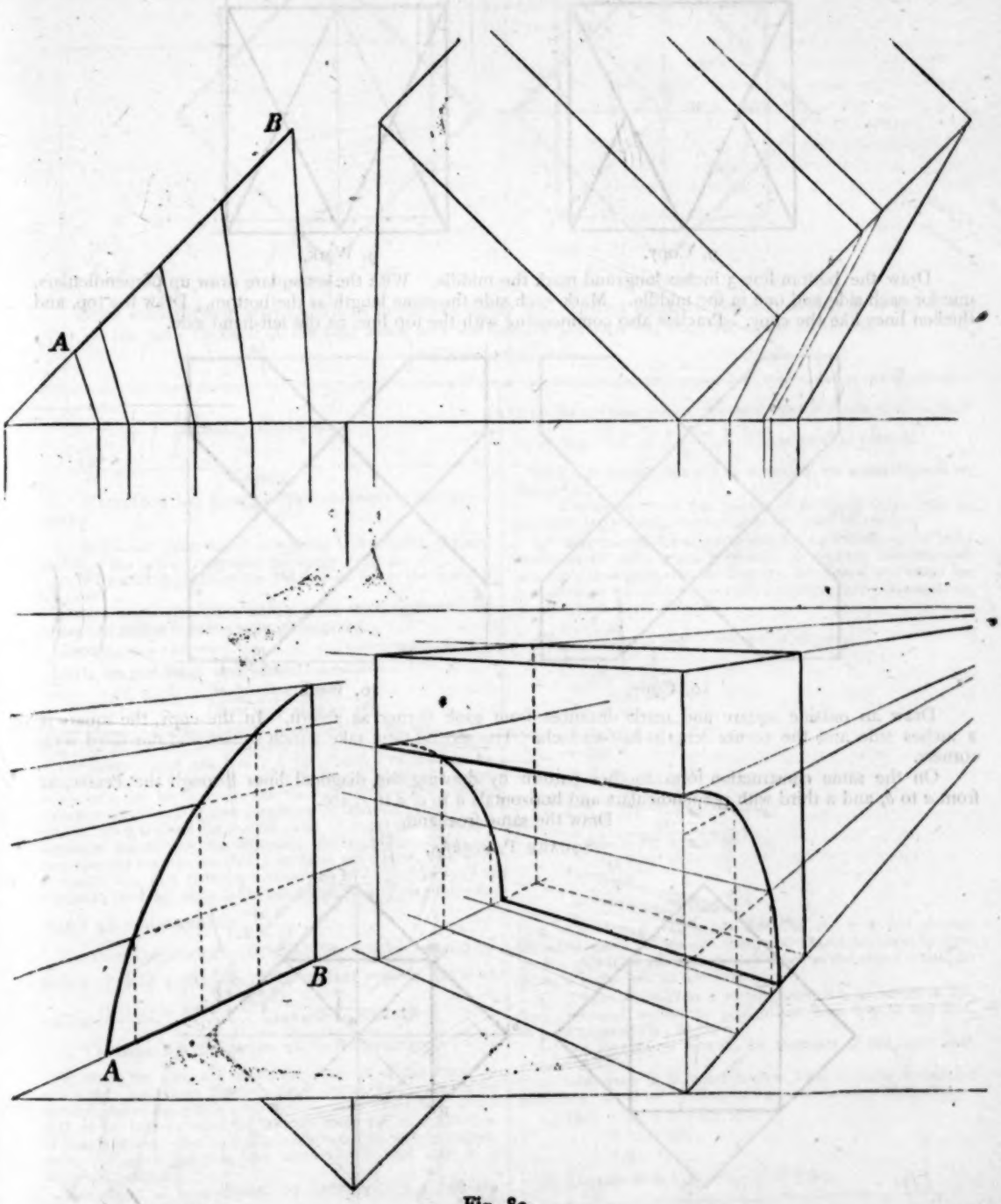
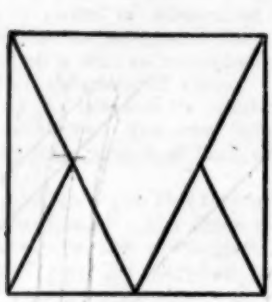


Fig. 82.

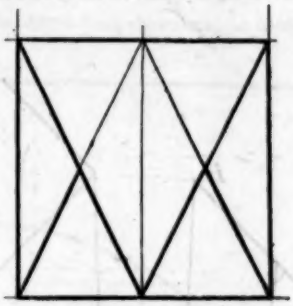
Teachers' Notes of Drawing Lessons for Standard III.*

By an Art Teacher under the London School Board.

SQUARE PATTERNS.

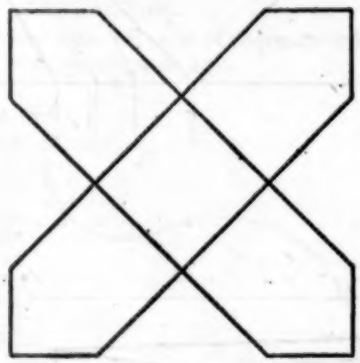


9. Copy.



9. Work.

Draw the bottom line 3 inches long and mark the middle. With the set-square draw up perpendiculars, one for each side and one in the middle. Mark each side the same length as the bottom. Draw the top, and thicken lines like the copy. Practise also commencing with the top line, or the left-hand side.



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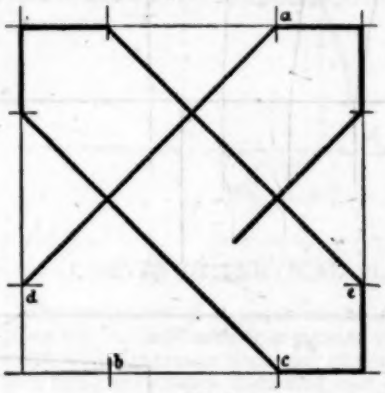


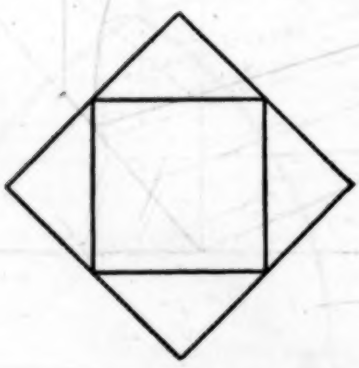
10. Work.

Draw an outside square and mark distances from each corner as shown. In the copy, the square is 2 inches side and the corner lengths half-an-inch. The second time take 3 inch square and one-third inch corners.

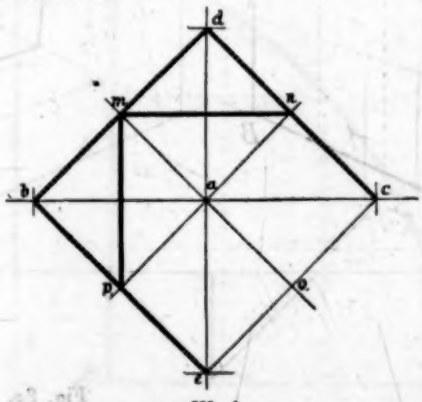
On the same construction form another pattern by drawing the diagonal lines through the centre, as from *a* to *b*, and a third with perpendiculars and horizontals *a* to *c*, *d* to *e*, etc.

Draw the same freehand.

SQUARE PATTERNS.



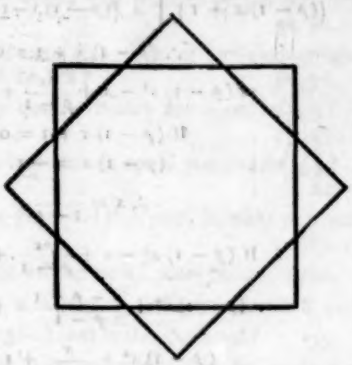
11. Copy.



11. Work.

* The Teaching of Drawing becomes compulsory on September 1st, 1891. These articles will be specially helpful to teachers who know but little of the subject. They will teach them how to teach it successfully.

Start with the horizontal centre line, marking a point for the middle and equal distances on each side of it *ac, ab*. With the set-square draw *ad*, lay the ruler along it and lengthen it to *e*. Mark *ad* and *ae* equal to *ab* and *ac*. Draw the four sides. Mark the middle of each side *m, n, o, p*, and before drawing the inside square, draw as a test of accuracy, the lines *mo, np*, which should cross in the centre of the figure.



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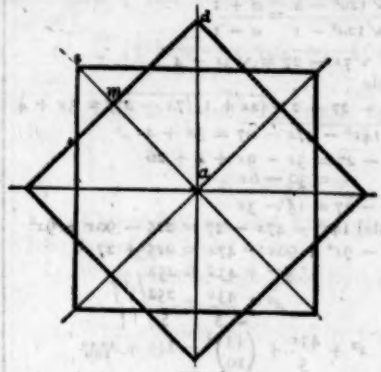

12. Work.

Draw construction lines exactly as in the last figure No. 11, then lengthen *am* to *s*, so that *as* is equal to *ad*. Do the same on each of the four sides, and see that the portions *ms*, etc., are equal all round.

(To be continued.)

Query Column.

General.

1. HOUGHTONIAN; EXCEL.—We cannot reply to anonymous queries.

2. JAX.—(*a*) Show that if everything else remains, the sensibility of the balance is greater the longer its arms.

(*b*) Why must the C.G. of the balance be below the point of support?

(*c*) How is the sensibility affected when the C.G. is removed further and further from the point of support?

Give reasons for answer. (*Science and Art.*)

(*a*) In the position of equilibrium of a balance

$$\tan\theta = \frac{(P - Q)a}{(P + Q + 2S)h + Wk}$$

where P and Q are the weights, a the length of an arm, S the weight of each scale, W the weight of the beam, h the distance of the fulcrum from the beam, k the distance of the fulcrum from the centre of gravity, and θ the angle which the beam makes with the horizon when there is equilibrium. For a given difference of P and Q the sensibility is obviously greater the greater $\tan\theta$ is; and for a given value of $\tan\theta$ the sensibility is greater the smaller the difference of P and Q is. Thus we may consider that the sensibility varies as $\tan\theta$ when P − Q is constant; also that it varies inversely as P − Q when $\tan\theta$ is constant; and so when both $\tan\theta$ and P − Q vary the sensibility will be measured by $\frac{\tan\theta}{P - Q}$.

Therefore the sensibility of a balance will be satisfied by making $(P + Q + 2S)\frac{h}{a} + W\frac{k}{a}$ as small as possible, that is by making $\frac{(P + Q + 2S)h + Wk}{a}$ as small as possible.

∴ The larger a is, the greater will be the sensibility.

(*b*) Since the arms are equal, the resultant of the forces on either side must pass through the fulcrum, and being there resisted, leave the whole apparatus at rest. Moreover, if the C.G. of the balance be at the fulcrum, there will be equilibrium in *every* position. But such a balance would be utterly useless, since, for equal weights, the arms should rest *only* in a *horizontal* position.

This object is accomplished by having the C.G. of the balance *below* the fulcrum.

The desired position is then one of *stable* equilibrium, to which the beam will revert when displaced from it.

(*c*) As has been shown, the sensibility of a balance is satisfied by making $\frac{(P + Q + 2S)h + Wk}{a}$ as small as possible.

Now it is evident that if h be increased, the sensibility will be diminished.

∴ The sensibility of the balance is gradually diminished as the C.G. is gradually removed from the point of support.

3. MECHANIC.—A screw, which has 24 threads to the inch, carries at its end a wheel graduated to degrees, minutes, and seconds; through how many degrees, &c., must the wheel be turned to advance the screw ·001 of an inch, and what advance would a turn of 20′ 30″ give?

(1) $\frac{\text{in.}}{\frac{1}{24}} : \frac{\text{in.}}{\frac{1}{1000}} :: 360° : \text{Number of degrees.}$

$$= \frac{360 \times \frac{24}{1000}}{\frac{6}{25}} \text{deg.}$$

$$= \frac{3 \cdot 1 \cdot 8}{1 \cdot 5} \text{ deg.}$$

$$= 8\tfrac{4}{5}°$$

$$= \underline{8° 38' 24''}. \quad \text{Ans.}$$

(2) $360° : 20\tfrac{1}{2}' :: \frac{\text{in.}}{\frac{1}{24}} : \text{Distance}$

$$= \frac{41}{360 \times 60 \times 2 \times 24} \text{in.}$$

$$= \frac{\cdot 41}{10368} \text{in.}$$

$$= \underline{\cdot 00004 \text{ in. nearly.}} \quad \text{Ans.}$$

4. CATERHAM.—It means that the eye is 5 feet perpendicularly above the ground plan, and 12 feet horizontally from P. P.; that is, a line from central vision to the object would be at right angles and 12 feet long.

5. DYER.—ABCD is a square, each side of which is 2 ft. long; forces of 10 and 12 pounds act from A to D and from A to B respectively: find

(*a*) the algebraical sum of the moments of the forces with respect to C,

(*b*) what point in BC must be fixed if the forces are to balance each other about it. (*Science and Art, Elementary Mechanics.*)

(*a*) Sum $= 12 \times 2 - 10 \times 2$

$= 24 - 20$

$= \underline{4}$.

(*b*) Distance from C $= \frac{12 - 10}{12}$ of 2 ft.

$= \frac{1}{6}$ of 2 ft.

$= \underline{4 \text{ in.}}$

Algebra.

1. FAC-SI-MILE.—Solve the following equations :—

(1) $\sqrt{2x+1}+\sqrt{7x-27}=\sqrt{3x+4}$.

(2) $\dfrac{x+\sqrt{12a^2-x}}{x-\sqrt{12a^2-x}}=\dfrac{a+1}{a-1}$.

(1) $\sqrt{2x+1}+\sqrt{7x-27}=\sqrt{3x+4}$

Squaring each side

$2x+1+7x-27+2\sqrt{(2x+1)(7x-27)}=3x+4$

$9x-26+2\sqrt{14x^2-47x-27}=3x+4$

$2\sqrt{14x^2-47x-27}=3x-9x+4+26$

$=30-6x$

$\sqrt{14x^2-47x-27}=15-3x$

Squaring each side] $14x^2-47x-27=225-90x+9x^2$

$14x^2-9x^2+90x-47x=225+27$

$5x^2+43x=252$

$x^2+\dfrac{43x}{5}=\dfrac{252}{5}$

$x^2+\dfrac{43x}{5}+\left(\dfrac{43}{10}\right)^2=\dfrac{252}{1}+\dfrac{1849}{100}$

$=\dfrac{5040+1849}{100}$

$=\dfrac{6889}{100}$

$x+\dfrac{43}{10}=\pm\dfrac{83}{10}$

$x=\pm\dfrac{83}{10}-\dfrac{43}{10}$

$\therefore x=4$, or $-12\frac{6}{10}$.

It will be found that the minus value does not satisfy the equation, and therefore the only solution is $x=4$.

(a) $\dfrac{x+\sqrt{12a^2-x}}{x-\sqrt{12a^2-x}}=\dfrac{a+1}{a-1}$

$\left.\begin{matrix}\text{Numerator}-\text{Denominator}\\ \text{Numerator}+\text{Denominator}\end{matrix}\right\}$

$\therefore\dfrac{2\sqrt{12a^2-x}}{2x}=\dfrac{2}{2a}$

$\dfrac{\sqrt{12a^2-x}}{x}=\dfrac{1}{a}$

$\sqrt{12a^2-x}=\dfrac{x}{a}$

$12a^2-x=\dfrac{x^2}{a^2}$

$\dfrac{x^2}{a^2}+x=12a^2$

$x^2+a^2x=12a^4$

$x^2+a^2x+\left(\dfrac{a^2}{2}\right)^2=12a^4+\dfrac{a^4}{4}$

$=\dfrac{49a^4}{4}$

$x+\dfrac{a^2}{2}=\pm\dfrac{7a^2}{2}$

$x=\pm\dfrac{7a^2}{2}-\dfrac{a^2}{2}$

$\therefore x=3a^2$, or $-4a^2$.

It will be found that the minus value does not satisfy the equation, and therefore the only solution is

$x=3a^2$.

2. MOOLAGHT.—Solve :—

$(p-1)^2x^2+px^2+\left(p-1+\dfrac{1}{p-1}\right)x+1=0$.

(*Todhunter.*)

$(p-1)^2x^2+px^2+\left(p-1+\dfrac{1}{p-1}\right)x+1=0$

$x\left[(p-1)^2x^2+px+\dfrac{1}{p-1}\right]+(p-1)x+1=0$

$x\left[(p-1)^2x^2-1+px+1+\dfrac{1}{p-1}\right]+(p-1)x+1=0$

$x\left[\{(p-1)x+1\}\{(p-1)x-1\}+\dfrac{p(p-1)x+p}{p-1}\right]$

$+(p-1)x+1=0$

$\{(p-1)x+1\}\left[x\{(p-1)x-1\}+\dfrac{px}{p-1}+1=0\right]$

$\therefore(p-1)x+1=0$

or $(p-1)x^2-x+\dfrac{px}{p-1}+1=0$;

If $(p-1)x+1=0$

$(p-1)x=-1$

$\therefore x=\dfrac{1}{1-p}$.

If $(p-1)x^2-x+\dfrac{px}{p-1}+1=0$

$(p-1)x^2+\dfrac{p-p+1}{p-1}x+1=0$

$(p-1)x^2+\dfrac{x}{p-1}+1=0$

$x^2+\dfrac{x}{(p-1)^2}=-\dfrac{1}{p-1}$

$x^2+\dfrac{x}{(p-1)^2}+\left\{\dfrac{1}{2(p-1)^2}\right\}^2=\dfrac{1}{4(p-1)^4}-\dfrac{1}{p-1}$

$=\dfrac{1-4(p-1)^3}{4(p-1)^4}$

$x+\dfrac{1}{2(p-1)^2}=\dfrac{\pm\sqrt{1-4(p-1)^3}}{2(p-1)^2}$

$\therefore x=\dfrac{\pm\sqrt{1-4(p-1)^3}-1}{2(p-1)^2}$

Tests in Mental Arithmetic.

STANDARD I.

1. There are 30 boys in a class, and 7 are absent ; how many are present ? 23.

2. What is the half of 30 ? 15.

3. Take 15 from a score. 5.

4. How many times can 5 be taken from a score ? 4.

5. How many times can 4 be taken ? 5.

6. If I had 6d., and gave 10 girls a halfpenny each, how much should I have left ? 1d.

7. If there were 24 girls, how much could I give them each out of 6d. ? ½d.

8. How much more than a shilling is 17 pence ? 5d.

9. What would ¼ lb. butter cost at 1s. 4d. a lb. ? 4d.

10. What would ¾ lb. cost ? 1s.

11. How many threepenny loaves could you buy for 1s. 6d. ? 6.

12. What would 8 loaves cost ? 2s.

Standard II.

1. What is the half of a dozen and a half? 9.
2. What is the half of two score and a half? 25.
3. How much would you want to give 9 boys 5d. each? 3s. 9d.
4. If that sum was given out of half-a-sovereign, how much would be left? 6s. 3d.
5. How many double florins are equal to £3? 15.
6. How many half-crowns could you get for £3? 24.
7. If John is 9 years old this year, in what year was he born? 1882.
8. [illegible]at year will he be 18 years old? 1900.
9. The divisor of a sum is 4, the quotient is 8, and the remainder is 3. What is the dividend? 35.
10. How many 2 oz. packets could be made out of a lb.? 8.
11. If a man earns 6d. an hour, how much would he earn in 2½ hours? 1s. 3d.
12. How many hours must he work to earn 3s. 6d.? 7.

Standard III.

1. Gladstone was born in 1809, how old will he be this year? 82.
2. How many more years must he live to be 100? 18.
3. Take 5 score from a gross. 44.
4. How many dozen are there in ¾ gross? 9.
5. How many 2 oz. packets can be made out of 4 lbs? 32.
6. If a lb. cost 6s., what would a 2 oz. packet cost? 9d.
7. What would ¾ lb. cost? 4s. 6d.
8. How many ozs. are there in ¾ lb. and 2 oz.? 14.
9. How many hours are there in ⅛ of a fortnight? 48.
10. How many quarter-hours are there? 192.
11. What would 7 yards cost at a halfpenny a foot? 10½d.
12. What would 2 yards cost at a halfpenny an inch? 3s.

Standard IV.

1. What would a dozen articles cost at 8¾d. each? 8s. 9d.
2. How much would 3 dozen cost? £1 6s. 3d.
3. What would half-a-cwt. of tea cost at 2s. 6d. per lb.? £7.
4. What would ¾ lb. cost? 1s. 10½d.
5. ½ yard + ¼ yard + ⅛ yard expressed in inches. 27.
6. What will 20 horses cost at £19 10s. each? £390.
7. What part of a yard is ⅓ foot? ⅓.
8. What part of ton is ½ cwt.? $\frac{1}{40}$.
9. How much will a man receive for the month of April, if he gets 3s. 4d. a day? £5.
10. If 5 bus. cost a sovereign, what will ½ peck cost? 6d.
11. If 15 hats cost 10s. 6d., how much would 5 cost? 3s. 6d.
12. How many could be bought for a guinea and a half? 35.

Standard V.

1. I spent half my money and 3d., and had a florin left; how much had I at first? 4s. 6d.
2. What number multiplied by 3 will give 40? 13⅓.
3. What number multiplied by 7 will give 40? $5\frac{5}{7}$.
4. How many caps at 11d. each can be bought for a sovereign? 21.
5. How much change would you get? 9d.
6. If ⅓ yard of cloth cost 1s. 9d., what will 4 yards cost? £1 1s.
7. Express 12s. as the fraction of a sovereign. $\frac{3}{5}$.
8. Give that as a decimal. ·6.
9. What is a hundredth part of that decimal? ·006.
10. What is 100 times that decimal? 60.
11. What is the interest on £3 15s. for a year at 5 per cent.? 3s. 9d.
12. How long would it take to gain 30s.? 8 years.

Standards VI. and VII.

1. A bankrupt owes £1,000, and has only £600; how much can he pay in the £? 12s.
2. How much would a creditor lose on a debt of £45? £18.
3. Divide a sovereign between a man and a woman, giving the woman 2s. for every 3s. the man gets. Man 12s., woman 8s.
4. A can do a piece of work in 4 days, and B can do it in 5 days; how much more can A do than B in a day? $\frac{1}{20}$.
5. How much could they do together in a day? $\frac{9}{20}$.
6. How long would it take them together to do the work? $2\frac{2}{9}$ days.
7. Express 15s. 6d. as the decimal of £1. ·775.
8. What fraction is 4 per cent.? $\frac{1}{25}$.
9. A boy lost 4 per cent. of his marbles, and had 48 left; how many had he at first? 50.
10. What is 300 per cent. of 7s. 6d.? £1 2s. 6d.
11. How much stock in the 3 per cents. at $94\frac{7}{8}$ can be bought for £3,800, brokerage being ⅛ per cent.? £4,000.
12. How much would be realised by selling £1,000 of the same stock, brokerage being paid? £947 10s.

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